THE TELEGRAPHIC JOURNAL.
Vol. II.—No. 36.

THE ELECTRIC CONDUCTIBILITY OF LIGNEOUS BODIES.*

By the COUNT DU MONCEL.

For some time I have observed that ligneous bodies are capable of transmitting electric currents, and that it is possible, under suitable conditions, to make them evident by sensitive galvanometers. It has been a matter of enquiry with me whether the ligneous matter of these bodies reckoned for anything, or whether we ought not to refer this physical action solely to the moisture with which these substances are always more or less impregnated, even when reputed *dry*. If this latter be the only true explanation, galvanometer experiments should give an easy method of measuring not only the humid condition of woods, but further the hygrometric properties of different ligneous species, an important result for the proper choice of wood to construct electrical instruments and apparatus of precision.

I have found from numerous experiments that ligneous bodies are endowed with a conductibility very appreciable to sensitive galvanometers, but *which should be chiefly attributed to the dampness of the air* with which they are always more or less impregnated, even when they are considered perfectly dry. It is very curious that the harder the woods, and the longer the time since exposure to the air, the more moisture do they contain. Thus, lengths of 6 centimetres of ebony, guaiacum, and iron woods in general, even after being for forty years shut up in a very dry chest of drawers, conducted a current from six bichromate of potash elements, and give a deflection of 90° on a sensitive galvanometer. This is owing to the fact that just as hard woods acquire their moisture slowly so they part with it with difficulty. Now it happens from this property that, though relatively moist, these woods when used in arts work less than others. This it is that explains the presence of the considerable rust which is often observed round nails and screws driven into pieces of the heart of oak used for ages in timber-work, and which has been thought to be thoroughly dried. To make amends soft woods much more readily abandon their moisture, and consequently their conducting property when dried, only, however, to re-absorb it again as quickly when they are placed in the presence of damp air. And it is this fact which at first sight creates the belief that soft woods after being thoroughly dried at a stove are in comparison with hard woods more hygrometric. But, though ever so little we follow for several consecutive days the fluctuations of their electric conductibility, we do not take long to acknowledge a progressive increase of the moisture in hard woods which does not exist in the other, and which eventually becomes very convincing. Amongst those hard woods which furnish the *most* conductibility after a longer or shorter time we will quote ebony, guaiacum, locust-tree, iron-wood of China, and box, &c. Amongst those which furnish the least we may mention mahogany, cedars in general, pear-tree, acacia, and white oak, &c. Lastly, for those which entail the greatest and most abrupt variations in passing from dryness to moisture, we may place in the first rank linden or lime-wood, chestnut, elm, beech, and white fir.

Believing that certain animal or vegetable bodies with open pores capable of absorbing moisture should behave somewhat like ligneous bodies, I experimented upon ivory, bone, horn, and scales of fish, and found that two of them conducted voltaic electricity tolerably well. Thus, causing a current, such as before spoken of, to traverse a piece of ivory 10 centimetres in length, a deflection of 50° on the galvanometer was obtained, and its conducting power—like that of hard woods—seemed to be greater the older the ivory, and the longer it had been exposed to the air. Horn gave me a deflection of 72°; bone a deflection of 10°; and the scale, undoubtedly on account of its "finish" during preparation, which placed it under the conditions of ebonite, did not conduct at all. Just like the woods, ivory, bone, and horn lost their conductibility when subjected to the stove, and retook it—to a small degree, it is true (at the commencement)—when exposed anew to the air; but, curious to relate, after treatment at the stove a tolerably large quantity (about 2 grms.) of a very limpid brownish-yellow liquid, thickening with cold, escaped from the ivory which was of a yellow-brown colour. It is no doubt to this liquid, which owes its origin to the absorbed moisture of the atmosphere, that we must account for the yellow-brown colour of old ivories and of those long exposed to the air.

One of the most interesting results of my experiments is the discovery of the manner the conductivity of ligneous substances varies according to the different hours of the day, and according to the moisture of the air. To study these variations I constructed with two pieces of wood the most opposite in their hygrometric qualities—viz., ebony and lime wood—two kinds of electric hygrometers, whose conduct I compared with Saussure's hair hygrometer, and with a thermometer, noting every three hours the indication of these four instruments. In this way I determined that the conductivity of the wood at the different hours of the day varies with the hygrometric indications, and almost proportionally with the moisture of the air; but that the maxima and minima of this conductivity are not observed until from three to six hours after those of the hygrometer. These maxima, indeed, in the month of July, showed themselves about 6 o'clock in the morning, whilst those of the hygrometer took place towards midnight; and the minima were at 6 o'clock in the evening, those of the hygrometer being at mid-day. True in these effects one ought to allow for the action of the sun on the woods, to which they were exposed from 1 p.m. until 7.30 p.m. In order that readers may judge of these effects we give one of a number of series of daily observations made for more than a month. This particular observation was taken on the 18th July, 1873. (See Table on next page.)

We see by this table, in confirmation of what has already been stated, that the variations are much sharper with *soft* than with *hard* woods; but as they had both been treated in the stove five days before the 18th July the ebony had not had time to absorb enough moisture to furnish its maximum of conductivity, and therefore it is that the lime wood

---

* Communicated by the Author.

	Conductivity.		Moisture of the Atmosphere.	Temperature.
	Ebony.	Lime.		
6 a.m. ...	24°	36°	47°	16° 5′
9 ,, ...	17°	25°	23° 5′	21°
12 ,, ...	12° 5′	11° 5′	22° 5′	22° 5′
3 p.m. ...	10°	7°	27°	22° 6′
6 ,, ...	0°	0°	35°	21° 3′
9 ,, ...	9° 2′	7°	48° 5′	19°
12 ,, ...	17° 5′	15°	50°	17° 5′

furnishes the greater deflections. Nevertheless, as this wood loses its moisture as rapidly as it takes it up, its conductivity becomes inferior to that of ebony after mid-day, and does not re-assume its superiority until after 3 o'clock in the morning. If we had given the daily observations preceding and following the 18th July, the progessive augmentation of the ebony's conductivity could have been distinguished notwithstanding its different hourly variations, and we should have seen that after a thick fog on the 19th, to which on the 20th had succeeded a notable diminution of the air's moisture, the ebony gave, at 6 o'clock each morning, the most considerable deflections (27° 5′ for 19th, and 25° for 20th).

It is very interesting to note that the pressure with which the communicating plates are fitted to the wood exercises a remarkable influence over the energy of the currents. In my experiments I used bronze vices; the galvanometer was one of 36,000 turns of wire, and the battery was made up of—as before mentioned—6 bichromate of potash elements. I have asked myself whether a lime-wood hygrometer, such as I have spoken of, and which does not retain the humidity it acquires, might not be fitted for use in meteorology (not to follow the humidity of the atmosphere, but to indicate the whole importance of it) in the same manner as maxima thermometers for temperature. This system would have the advantage that it could be placed in any spot whatever, and that the indications could be supplied in the cabinet of the observer. By comparing the maxima thus indicated he could ascertain the excess of moisture on such a night over any other, and he could deduce important observations not only for meteorology, but also for the conditions of vegetation.

In conclusion, I desired to measure the conductivity resulting from the condensation of moisture on the surface of bodies, and, as wood—by reason of its absorbing faculty—could not be used, I had recourse to substances such as ebonite, gutta-percha, glass, resin, porcelain, and even paper, which I freely exposed in air, and upon isolating supports I arranged some tables so as not to make the observation until the moment of the formation of the dewdrop, so as not to be troubled by the little liquid drops. By choosing a rather dry serene night I have been able to ascertain that these conductibilities were very minimum, and could not be measured until towards 6 o'clock in the morning. They were—for porcelain, 6°; for glass, 8°; for ebonite, 5°; for resin, 5°; and for gutta-percha, 5½.° Paper showed a conductivity of 22°.

Messrs. Siemens Brothers have received a telegram from Halifax announcing that the Direct United States Cable has been laid from Nova Scotia to Newfoundland, and that insulation is perfect.

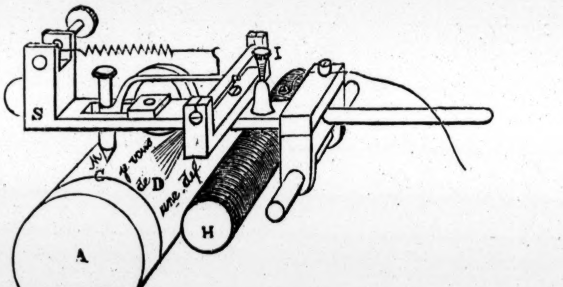
MEYER'S AUTOGRAPHIC APPARATUS.

Caselli, the abbot, was the first to reproduce at a distance, by telegraph, the exact facsimile of the despatched message. His electro-chemical instrument, used for many years in France, was on view at the 1867 Universal French Exhibition.

About that date M. Meyer, without recourse to chemical decomposition, succeeded in reproducing the facsimile in ink upon ordinary paper. His apparatus greatly simplified Caselli's, which it substituted from the year 1868. Its description is as follows:—Upon a brass or wooden table is placed a clockwork movement. On one side of it are a cylinder and slider, mediums for transmission; on the other side are the spiral cylinder and endless paper for the reception of messages. The motor is a weight, and the motion is regulated by the vibrating pendulous stem whose function is to establish a regular and synchronical action between the sending and receiving stations. There are therefore three portions to describe, viz., the transmitter, the receiver, and the synchronism system.

The Transmitter.—The sender writes his message with an insulating ink upon a certain limited surface of metallic paper, sometimes as large as 1 decimetre, but more generally for the public, 30 square centimetres. As to the metal-paper, it is the usual tin or silver paper of commerce. The despatch, design, or whatever may be on the paper, is wound round the cylinder A, which is 1 decimetre in circumference, and turns with a speed of 75 revolutions a minute. Upon a support, parallel to the cylinder's axis, slides the slider, furnished with the style or platinum point, C. I is a screw whose point enters into the thread of the endless screw H, which in turning moves the slider from right to left. When the cylinder A makes one revolution the slider advances ¼ of a millimetre and the style C describes a complete helical turn. The cylinder continuing to revolve, the style performs upon its circumference a helical line whose spirals are distant ¼ of a millimetre from each other. Now, as the message to be transmitted occupies the surface of the cylinder, all the points* of the message are successively in contact with the style, which, in its course, alternately touches an inked and a metallic surface in an irregular order, according to the contents of the message. The current passes during the passage of the style over the metallic-paper surface; it is interrupted on the insulated ink part, and it is this succession of makes and breaks which

Fig. 1.



---

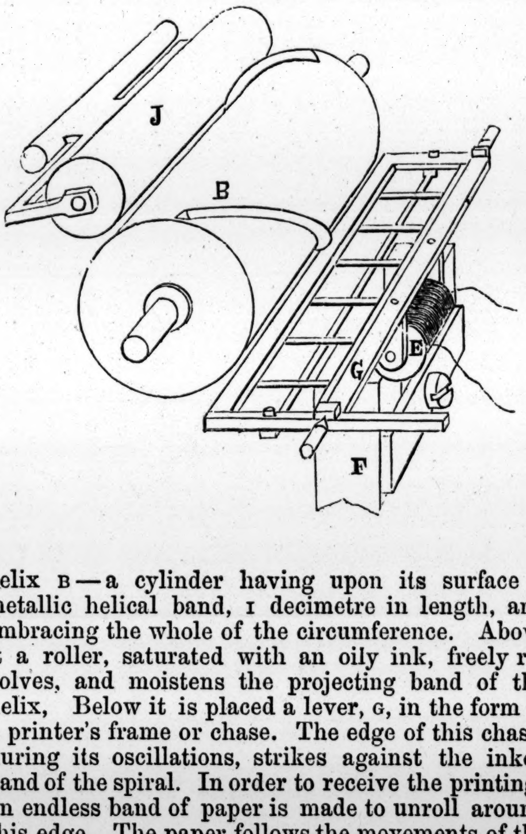
* Excepting a very fine spiral line, ¼ m.m., or nearly 1-100th of an inch, broad.

constitutes the autographic transmission. The current from the battery divides in the sending portion of the instrument into two branches; the one by the line wire, and the other to earth through the slider and the brush, D, which rubs against the metallic sheet of the message.

The result of this arrangement is that the battery always works, and it is the position of the style *c* which determines the distribution of the current by one or the other circuit. When it rests upon the metal the local circuit is closed; all the current goes to earth through the style, the metallic surface, and the brush: and the line—on account of its great resistance—receives only a branch current which may be neglected. On the contrary, when the style passes over the inked portion, the local circuit is interrupted, and the whole battery charge goes to line. There is therefore an emission of the current on the line every time that the style passes over the writing, and a breakage of the current or discharge to earth every time the style touches the metal-paper.

The Receiver.—We now shall describe how these successive currents reproduce, in an exact form, the transmitted message. The principal part is the helix B—a cylinder having upon its surface a metallic helical band, 1 decimetre in length, and embracing the whole of the circumference. Above it a roller, saturated with an oily ink, freely revolves, and moistens the projecting band of the helix, Below it is placed a lever, G, in the form of a printer's frame or chase. The edge of this chase, during its oscillations, strikes against the inked band of the spiral. In order to receive the printings an endless band of paper is made to unroll around this edge. The paper follows the movements of the chase. It is 1 decimetre in size, and the width of the cylinder B. The paper band, pressed between two revolving cylinders, unrolls itself ¼ m.m. per turn of B. It has been shown that the style advances the same quantity for each revolution of the cylinder. Consequently the surface of the paper band run out in a given time is the same as the surface traversed in the same time by the style. When the cylinder B makes one turn its band traces upon the paper a straight transverse line in ink, which is repeated for each turn. These successive transverse lines, distant from each other ¼ m.m., for all purposes touch and form upon the band of white paper a blue ground. Thus the cylinder B is the writing medium of the apparatus. At the lower part of the lever G is screwed E, a small straight electro-magnet, whose soft iron bar serves for an armature to F—a permanent horse-shoe magnet. When the coil is traversed by a current the extremities of the core take the same polarities as the poles of the permanent magnet, and the lever G is then repulsed. The edge of the chase quits contact with the cylinder, and some white appears on the paper,—in size according to the length of time the current traverses the coil of the electro-magnet E. On the cessation of the current the core of the magnet E is attracted by the permanent magnet F, and the paper is again pressed against the cylinder.

Fig. 2.



We have previously described how, at each passage of the style on the ink, the battery current flows to line. This current works a relay at the receiving station.

Now the cylinders A and B perform their revolutions in the same time. The slider *c* describes then as many spirals upon the cylinder A, and equally spaced, as the cylinder B traces parallel dashes. Thanks to the synchronic movement which animates the two apparatus, the course of the slider rigorously coincides with the rotation of B, and when the style is found at the commencement, in the middle, or two-thirds of the circumference of the cylinder A, B presents to the surface of the paper a point at the commencement, or in the middle, or two-thirds, of the paper band in the direction of its breadth. Consequently all the inked parts which meet the style during the first revolution are interpreted, at the receiving end, by dashes corresponding in length with the duration of the passage of the style over the ink. The same takes place for all succeeding turns.

The success of the invention depends on the mechanism by which the movements of the instruments at the receiving and sending stations are controlled. The regularity, as before mentioned, is obtained by the use of a conic pendulum, which is a stem supporting a ball of a certain weight. When two pendulums thus constructed are set in motion to the same pitch, they describe sensible isochronous amplitudes, maintaining the concordance of the two apparatus for several minutes—a time sufficient to traverse the whole of the cylinder.

ELECTRO-DEPOSITION OF METALS.

By J. T. SPRAGUE.

(Continued from page 239.)

The Daniell cell is not very much used in metallurgical operations, on account of the trouble of the porous cells and the annoyance caused by endosmose of the liquids. This cell was, however, the source of the discovery of the art of electro-metallurgy, as in it metal was seen reduced in a coherent state, and on removal of the deposit from the cylinders on which it was formed the marks and scratches were observed exactly reproduced in the reverse condition. All the early experiments in electro-deposition at the time of the first discovery, when nearly every one had a little cell in operation copying seals, coins, &c., were carried out by the single cell process without a separate battery, and the single cell apparatus is neither more nor less than a Daniell cell, in which the article to be deposited on takes the place of the copper cylinder.

It would appear from the figures, shown p. 238, that a well-considered economy would result in the adoption of the Daniell cell as the source of power in all cases in which there is any use for the deposited copper. The cell has also an indirect value which has not been pointed out in works upon the subject; it serves very fairly to measure the work it does. The sulphate of copper contains close upon one-fourth its weight of metal; therefore if a saturated solution is used in the cell, and the extra crystals are so arranged as to dissolve freely and maintain the solution, we need only to put in the reservoir four times in crystals the weight of copper we require deposited (or for other metals the proper equivalent proportion), and as soon as the crystals are dissolved we are pretty sure the desired weight is very nearly deposited. We may in this way even control the rate of deposit upon each one of many objects placed in the same vat, although the actual work is effected by a large Smee or other battery, or a magneto-electric machine. To do this the objects require to be suspended by separate conducting wires instead of from a general conductor, and this wire should be connected to the zinc of a Daniell large enough for the single object: the coppers of all the Daniells should then be connected to the negative pole or zinc of the general large battery, and a general large or divided anode to its copper. In this way, as will be more particularly explained hereafter, perfect control may be exercised over each single article or cluster of articles in a large vat.

For use in electro-deposition it is obvious that the Daniell should be arranged not in cylinders, but as plates in an oblong or square cell, in the middle of which the zinc should be placed. The zinc cell may be a fixture, made by two porous plates cemented in, or a large flat cell may be used, or a row of circular ones; in any case the zinc should be in more than one plate as described for the Smee, and be kept free from deposit of copper by brushing with a hard brush or iron wire card. The zinc plates may be clamped to a metallic bar crossing the cell, but for saving of labour it is better to replace this by a bar of wood with a trough cut in it, or by a trough of copper or iron containing mercury. A copper wire either clamped, rivetted to, or cast in the zinc is bent over, its end amalgamated and slung into the trough; the zinc is thus instantaneously removable. The best way to amalgamate copper or iron is to clean them, rub the surface with nitric acid, and then dip in or pour the mercury over; a very perfect amalgamation is thus quickly obtained, which is not the case with the process usually employed of washing with nitrate or bichloride of mercury.

Amalgamated zinc and the common acid solution should not be used with Daniell cells if economy is considered. Copper salt always finds its way in deposits on the zinc; if this is amalgamated the mercury fixes the copper, and then a violent local action is set up, and zinc and acid wasted; if unamalgamated zinc and a saline solution are employed no waste arises except that due to the actual copper salt itself, and the copper forms a powder easily brushed off; even cast zinc plates may therefore be used, though they are more troublesome than rolled plates. Common salt may be used, but it has disadvantages; probably the liquid most suitable is the half saturated solution of zinc sulphate which keeps on forming, so that it is only necessary to occasionally remove part of the contents of the zinc cell and fill up with water. Some of the zinc salt finds its way into the copper solution, but is of consequence only so far as it affects the resistance. After a time it may be well to evaporate the solution off, but the crystals formed will contain zinc, as the sulphates of copper, iron, zinc, and also several of the alkalies and earths form compound crystals.

The copper plates or objects to be coated are hung in the solution by wires slung on or clamped to a metal bar placed across the cell, one on each side of the zinc compartment; if the objects are small or irregular in form, two or more such bars may be used; or when objects are to be coated all round or hollow vessels formed, &c., it may be desirable to alter the arrrangement and have the copper solution in the middle.

The porous vessels or plates used in the Daniell are subject to the formation of nodules of copper, which grow and at last break the cell. They appear to be due to the presence of conducting materials in the substance of the cell which set up a polarity and decomposition of their own; this, it will be shown, occurs with any conducting body, though insulated, which is in a solution undergoing electrolysis. The most common cause appears to be contact of the zinc against the cell or of particles of metal falling from the zinc, as the nodules form chiefly near the bottom; for this reason it is well to destroy the porosity of the bottom by saturating it with tallow or, still better, melted paraffin; when nodules form they should be covered by drying the cell and applying these materials over and around the spot. It is a great advantage to have the part of porous vessels above the liquid made non-porous by glazing when made. Some one has recently patented this, in fact, although the plan has been often used for years. The simplest mode of rendering such parts non-porous is to stand them in a flat vessel in a quarter inch of paraffin kept just above the melting-point till it has soaked up as far as is desirable. If this is not done, as the salts creep up and crystallise, they become a great nuisance, destroying wood or metals which they touch, and the porous material itself disintegrates and splits off.

Nitric acid cells, usually Bunsen's, with a block or plate of graphite carbon in a porous cell, are employed for some purposes in electro-metallurgy where a strong current is required; but except for such occasional purposes their employment is not desirable, as the fumes they give off are a great nuisance, destructive to surrounding objects and very prejudicial to health. They produce an effect upon the lungs which renders them very susceptible to disease, and even the occasional and slight breathing of nitrous fumes leaves injurious effects. When these cells are used they ought to be placed in the open air or under a chimney. The advantages of the nitric acid cells are a high electromotive force and an internal resistance so small that it leaves a large proportional share of the energy available for the work to be done; for internal resistance of the battery plays in electrical operations much the same part which friction plays in mechanical operations; it is an inevitable adjunct of our appliances, but it uses up the energy and should be carefully watched and reduced to a minimum.

I may here incidentally point out the advantage of working out and understanding definite principles. In the abstracts of foreign papers, p. 233, there is one by M. Koosen, in which it is remarked:—"From this rule, that the electromotive force is independent of the concentration of the liquid in which the electro-negative metal is immersed, nitric acid seems to be a solitary exception (and the author seeks to explain it)." Now it is not a solitary exception, it is not an exception at all, but a fact according with a general fundamental law; this law and the causes of it are self evident when the general principles of the conversion of any other forms of energy with electrical energy are understood. The principles explained in this Journal, p. 135, April 15, and the preceding and following articles of this series, exhibit plainly why the electromotive force of nitric acid varies with its degree of strength; for the same reason sulphuric acid likewise varies to some extent, but its effect is not so important as in the other case, as it acts chiefly on the resistances. The reason is this—nitric acid in combining with water gives up heat; it has therefore parted with a portion of its intrinsic or internal energy; as a necessary consequence, when it is called upon to supply energy as electricity, it *has just so much less to give up*. Reckon all this in equivolts and it will be found that the lower electromotive force of dilute acid corresponds to the heat given up in dilution. So in all operations when a salt in solution gives up or absorbs heat, an equivalent effect will be produced in the electromotive force needed to decompose it in the electric resistance to conductivity, or in some form which shall involve the exact replacement of the energy already charged upon or removed from the molecules of the substances which form the path of the electric current. This shows clearly the advantage of such a unit as the equivolt; as long as we reckon heat by one unit, electricity by another, and mechanical energy by a third, and so on through all the forms of energy, we can only discover their relations by a direct search or by accident; but if we express them all in one unit, the correlations show themselves by merely looking at the figures; the effect is like that produced upon arithmetic by substituting our unitary figures for the old arbitrary alphabetical notations. Would it have been possible for people using the Roman numerals to have discovered logarithms or any of the advanced arithmetic?

METHOD OF FINDING FAULTS IN INSULATED WIRES.*

By THOMAS T. P. BRUCE WARREN.

The following directions for performing this test are given by Mr. Latimer Clark (Clark and Sabine's "Electrical Tables and Formulæ"). The object of the present paper is to give the more recent methods of employing this test.

"The coil of wire is wound on two separate drums, both insulated, and an electrometer connected to each. A powerful battery is connected to one end of the conductor, the induction and leakage through the dielectric causing each of the electrometers to become deflected. Both drums are now discharged by touching them with the hand, and the electrometers fall to zero. The drum which has a defect on it, however, soon acquires its tension again, and its electrometer is deflected, the other remaining unaffected. More wire is then unwound till the fault appears on the other drum. The outside of the wire between the drums must be wiped very dry; the other parts should be moist."

This method of performing the test was soon abandoned, from its being cumbersome and badly adapted for locating very minute faults, as by the use of two electrometers with different degrees of sensitiveness it was impossible—unless by carefully comparing them—to say on which drum the fault was. Although a galvanometer can be used for the test, an electrometer was preferred, from the fact that the deflected position of the needle or indicator is independent of the length under test, which, by the implied condition of the test, is variable. Obviously with a galvanometer the deflections alone could be but little depended upon.

The electrometers first used were a modified form of Coulomb's torsion instrument by Mr. Latimer Clark, which was replaced by a more sensitive arrangement of Peltier's electrometer which I had constructed. This in turn gave way to Sir William Thomson's quadrant electrometer, which, under skilful manipulation, is the most certain and convenient instrument, especially for demonstration, as a few yards of core will suffice for the experiment. In practice an ordinary reflecting astatic galvanometer is generally used, in which case, instead of being guided by the deflections, we note the rush of current into the core when each drum alternately is connected to earth after a few moments previous insulation.

I will first describe the method employed when an electrometer is used. The length of wire to be operated on is immaterial, provided that the whole or a portion of it can be coiled on an insulated drum, and that between the parts coiled the surface of the core—for a length of 6 or 8 inches—can be cleaned and dried so as to prevent conduction.

In the first case (when the whole can be coiled on a drum) one-half is coiled off on a second drum, and the two drums A and B afterwards carefully insulated. The 6 or 8 inches surface of the core, which call C D, between the drums above referred to is well cleaned and dried. The conductor is attached to an electrometer, and the two drums are connected to earth by an attendant at each drum, when by connecting the battery to the electrometer and core the whole will become charged: the battery is then disconnected from the electrometer, and the earth-wires simultaneously taken off the drums. It is best to leave the battery on until the earth-wires are removed from the drums.

The insulation of the drums A and B and the electrometer should be such that no loss can be perceived after a few minutes, when, if the earth-wire be applied first to one drum and then to the other, the fault will be found on that drum which causes the greatest fall in the electrometer. The wire is coiled from the faulty side to the other, and the test repeated as often as is required. A mile of core with a small fault in it can, by a little practice, be put right in an hour or two, involving no more waste than the insulator, which can be held between the fingers, and without even cutting the conductor.

---

* From the "Philosophical Magazine," June, 1874.

It is obvious if C D represent a joint it may be tested by this method with great ease. In fact, so delicate is this test when used for joints in this way that if A and B each be 2 or 3 miles in length, and C D—a length of 10 inches—be slightly heated above the portions on A and B, the difference in insulation will be readily perceptible on the electrometer when this portion is connected to earth. The limits to the delicacy of the test are only reached when A and B are absolutely insulated.

In the second case, where the bulk would prevent the whole from being insulated, we should continue to coil the core upon an insulated drum until the fault disappeared—that is, until it was coiled on the drum. This is a useful method when dealing with "served core" at a cable factory.

When a galvanometer is used the corrections are as for ordinary insulation-tests. The galvanometer is short-circuited; and A and B, whilst connected to earth, are charged as before. The earth-wires are removed, and the short-circuit key opened. The drums are after a few moments connected to earth alternately, when the loss of charge is soon rendered visible on both sides; but as the lengths on A and B may be very unequal, the rush of current alone will not enable us to say on which side the fault may be; but by carefully watching the electrification for an equal time on each side, no difficulty will be found in fixing upon the drum containing the fault.

Two or more faults existing together form no embarrassment to the test. All to be done is, if the faults are of unequal magnitude, to remove the more extensive first, or to keep one side right by removing the faults as they are coiled over to it. In any case the battery power required will vary with the magnitude of the fault and the sensitiveness of the instrument.

Students' Column.

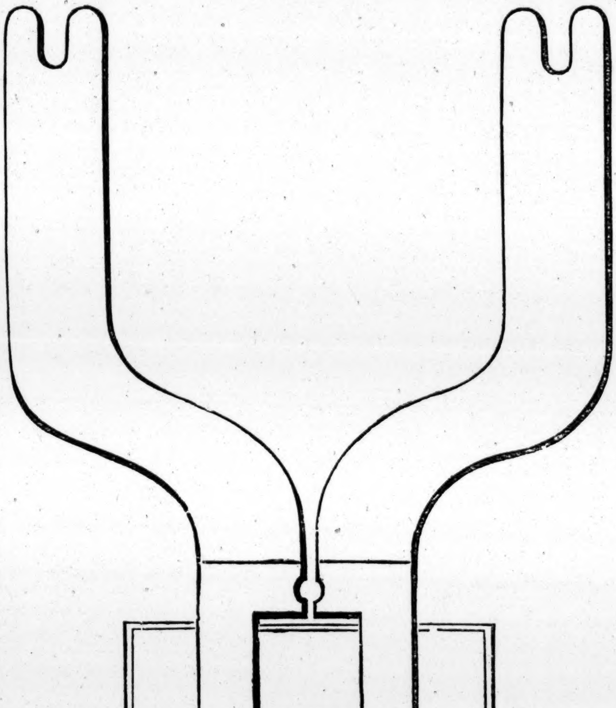
Resistances and their Measurement. By H. R. Kempe.

XII.—The height of the table upon which the instruments are placed, when working with a Thomson galvanometer, depends a good deal upon the fancy of the experimenter, but, as the work is usually done most conveniently standing up, the table should be higher than an ordinary one; from 3 feet 6 inches to 4 feet is a good average height. The presence of iron near the instrument is not prejudicial to its correct working, so long as it remains remains stationary. The experimenter should, however, remove any iron, in the shape of keys or knives, he may have about him, as they very much affect the galvanometer if he moves about much. These precautions may seem almost unnecessary, but as the very object of the Thomson galvanometer is to enable measurements to be made with accuracy, all likely causes of disturbance should be avoided.

If the fibre of the instrument by any chance gets broken the top front plate must be removed, when the coil which it secures can be removed, and the mirror and its appendages got at. Care should be taken, when replacing the fibre, that only a single thread from the cocoon silk is used, or the sensitiveness of the instrument will be much diminished. The operation requires care, and must be done in a room free from draughts. When the ends of the fibre are passed through their respeceive holes, and tied, a small drop of shellac varnish may then be dropped on them, which will prevent their becoming loose. It is as well to let the needles remain suspended from the fibre for a time, so that it may become stretched to its normal length before being used. The suspending stud should always be pressed down before removing the instrument.

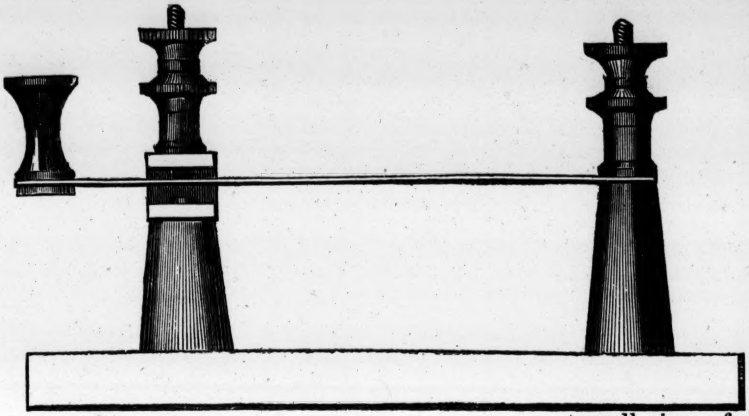
A resistance-box, containing three shunts, is provided with the galvanometer, of the values $\frac{1}{9}$th, $\frac{1}{99}$th, and $\frac{1}{999}$th of the resistance of its coils, which values, as we have before shown, are necessary in order to be able to reduce the sensitiveness of the galvanometer to its $\frac{1}{10}$th, $\frac{1}{100}$th, and $\frac{1}{1000}$th part respectively. Fig. 18 shows a form of this shunt.

Fig. 18.



These shunts, if carefully adjusted, are very useful. Some good electricians, however, object to their use on the ground that their variation in resistance by temperature does not accord with the variation in resistance of the galvanometer, and that, consequently, they are only correct at the temperature at which they were constructed. Other good electricians, however, use them, and consider them correct.

Fig. 19.



The two broad strips of copper shown in the figure are used for the purpose of connecting the box with the galvanometer. The blank plug-hole is for the purpose of short circuiting it.

Fig. 20 A.

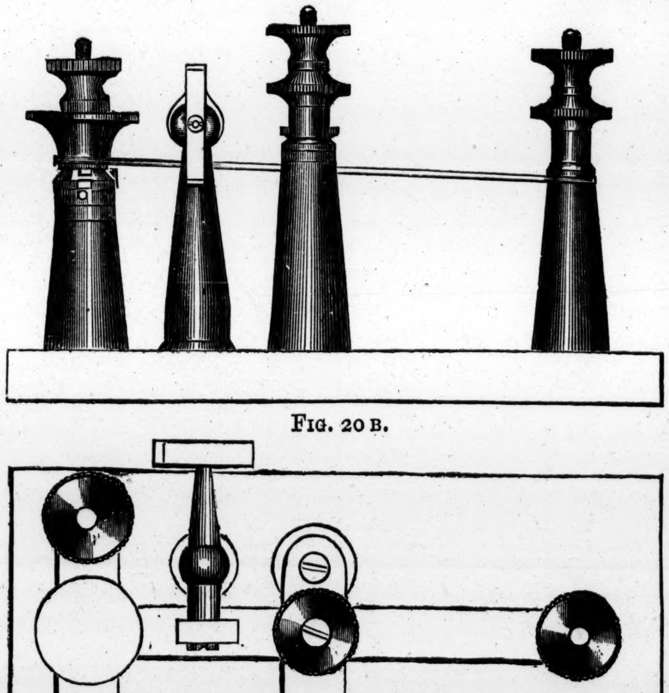
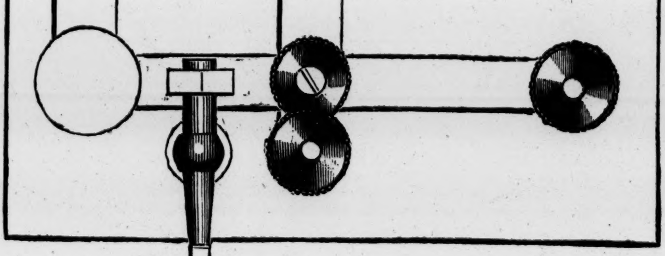


Fig. 20 B.



Although this short circuit plug-hole is convenient to avoid accidental currents being sent through the galvanometer, when the various resistance coils, batteries, &c., are being joined up for making a measurement, yet a key which in its normal condition short circuits the galvanometer is extremely convenient and useful. Such a key is represented by Fig. 19. In its normal condition the spring rests against a platinum contact, and, when pressed down, against an ebonite one.

The two terminals of the shunt are connected to the terminals of the key, which in this and most keys are double, so as to enable two wires to be attached conveniently, the wires leading to the resistance coils, batteries, &c., being also connected to them. If it is required to keep the key pressed down for a lengthened period, a small piece of ebonite or gutta-percha can be slipped in between the contacts, so as to prevent their making connection when the finger is taken off the key. Some keys of this kind are provided with a catch, which keeps the spring down when it is depressed. The advantage of the short circuit key over the short circuit plug may not seem obvious, but actual practice will soon show the careful experimenter its great use.

Besides the short circuit key, a reversing key is usually inserted in the galvanometer circuit, so that the deflections of the needle may be always obtained on the same side of the scale. A form of reversing key very commonly used is shown in plan and elevation by Figs. 20 A and 20 B. The galvanometer terminals would be connected to the two end terminals, or, if the short circuit key is inserted, tothe terminals of that key. By pressing down one or other of the springs the current will pass through the galvanometer in one direction or the other. The two handles on either side of the two springs are for the purpose of clamping either of them down when required. In Fig. 20 A one of the springs is shown as clamped down. It should be seen, when procuring the keys, that the terminals, &c., are not fixed on the top of the ebonite pillars by bolts running right through them, as in such a case their advantage is entirely lost, and the terminals might just as well be screwed direct into the base board. Care should be taken that the contacts in the keys are clean, as when there are several contacts considerable resistance might be introduced in the circuit from their not being so.

In addition to the reversing key for the galvanometer, a reversing switch for the testing battery is very useful: it need not, however, be such an elaborate one as that used for the galvanometer. We shall give a sketch in the next article of such a switch. Besides the testing battery, which should be of about 100 cells, a single cell—whose use will be explained—should be provided, which may be conveniently placed in a small box with the terminals outside. The form of battery known as the "Sawdust Daniell" is the most convenient one to employ. The Leclanché battery is used at some cable factories with success, and they have the advantage of great electromotive force, but are not so constant as the Daniell. The batteries should be placed on well-insulated supports, in a dry situation, so as to avoid leakage, which interferes with the constancy of the current.

(To be continued).

Errata.—In last article, at top of page 243, *for* "one-third full size" *read* "one-fourth full size."

Correspondence.

THE DUPLEX SYSTEM ON LONG SUBMARINE CABLES.

To the Editor of the Telegraphic Journal.

Sir,—I have just seen a copy of your issue of the 15th of June, and notice Mr. De Sauty's letter on the subject of "Duplex Telegraphy" as applied to long submarine cables.

Mr. De Sauty is to be congratulated on his success after so long a period as fourteen months of experiment. Permit me, however, to point out that Mr. De Sauty's is not the first solution of the problem of Submarine "Duplex" Telegraphy as applied to long cables, as would seem to be claimed by his letter.

On my arrival at this station in June of last year, I found Mr. De Sauty here experimenting on the matter. The instruments used at both ends were Thomson's "Recorders," and Mr. De Sauty found, on charging and discharging the line, that a sudden jerk of the syphon took place at the home end, which he called the "kick." All his attempts to neutralise this having failed, on the 6th July he returned to Gibraltar, expressing his fear that this difficulty would prove fatal to the success of the system.

After Mr. De Sauty's departure I selected one of the Company's Alexandria cables on which to experiment, as, having duplicate cables, the traffic would be less interfered with than had the Gibraltar cable been chosen.

Foreseeing that the first subject to which attention should be directed was the "kick," my experiments were made with a view to ascertaining its cause and the means of removing it. This difficulty being overcome, I anticipated no obstacle to the practical application of the system to the Company's lines. I eventually succeeded in readily producing or nullifying it at pleasure, and on the 22nd July, 1873, I had the pleasure of informing our London Head Office that I had succeeded in working the "Duplex" system between our Malta and Alexandria Stations—a distance of 911 nautical miles. As a test of the arrangements, the cable was kept connected up for the "Duplex" during the whole of the 21st of that month, for a considerable portion of which time the traffic was passing on the "Duplex" system.

Of course success on such a length of cable rendered success on any other line of approximately similar length—such as the Gibraltar-Malta Cable—a mere matter of adjustment; but in order to satisfy myself I, at the commencement of September, transferred my arrangements to the Gibraltar cable, and had the satisfaction of reporting, on the 3rd of September, that signals—as nearly perfect as possible—had been transmitted between here and Gibraltar on this system.

Nothing but lack of sufficient apparatus has prevented the system being established on this Company's lines for months past.

As my experiments were made in the Eastern Telegraph Company's interest, solely at their expense, and with their cables and apparatus, I did not consider myself at liberty to make public, through your Journal, the means by which I had attained success, but I may incidentally mention that a full account, with a drawing of the *modus operandi*, was sent to Mr. De Sauty at the time.

I do not wish to impugn Mr. De Sauty's claims to originality, as I do not doubt his plan will be found to be different to mine; my object in writing is to correct the impression his letter is calculated to produce—that Mr. De Sauty was the first to successfully apply the "Duplex" system to long submarine cables.—I am, &c.,

B. Smith.

The Eastern Telegraph Company,
Malta, July 10, 1874.

Electrical Science in English and Foreign Journals.

(In addition to our usual abstracts, there will be found under this heading the titles of papers on electrical science which have appeared in English and foreign journals from the commencement of the present century up to the date of the establishment of this journal).

Poggendorff's Annalen der Physik und Chemie.

Vol. XXXVII. (1836).

Determination of the Magnetic Declination and Inclination at Stockholm and Upsala. M. Von Humboldt. P. 191.

Inclination and Declination Observations at Kasan. M. Von Humboldt. P. 195.

On Voltaic Electricity, on the Electricity accompanying Chemical Actions, and on the Properties through which Electricities of Different Origin can be distinguished from each other. M. Arago. P. 225.

On some Electro-magnetic Phenomena. M. Von Humboldt. P. 241.

On the Conductivity, for Electricity, of Iodine, Bromine, and Chlorine. Mr. Solly. P. 420.

On the General Magnetic Relations and Characters of Metals. Mr. Faraday. P. 423.

On an Electro-chemical Apparatus serviceable for Decompositions, like the Voltaic Pile. M. Becquerel. P. 429.

On an Electric Current which produces Chemical Decomposition on Low Heating. M. Becquerel. P. 433.

On the Electricity produced by Friction of Metals. M. De la Rive. P. 506.

On Periodic Variations of the Magnetic Declination on 20th March, 1836, and Secular Decrease of the same in Berlin and Königsberg. MM. Erman and Herter. P. 522.

On a New Period in the Variation of the Magnetic Declination. MM. Von Humboldt and Simonoff. P. 526.

Remarks on Terrestrial Magnetism. P. 558.

On Bound Electricity. M. Riess. P. 642.

Vol. XXXVIII. (1836).

Electric Sparks and Torpedoes. MM. Linari and Matteucci. P. 291.

On the Action of the Armature on Electro-magnets and Steel Magnets. M. Magnus. P. 417.

Galvanic Combinations. M. Delffs. P. 464.

On a Remarkable Stroke of Lightning. Mr. Oswald. P. 543.

Vol. XXXIX. (1836).

On the Variation of the Magnetic Inclination and Declination, on the Influence of Aurora on these

Phenomena, and on the Temperature of the Ground. M. Rudberg. P. 107.

Declination Observations in Tokutzk, and Influence of Earthquakes on these. M. Erman. P. 115.

On Becquerel's Simple Galvanic Apparatus to be used for Decomposition. M. Mohr. P. 129.

On the Magnetic Influence of an Aurora. M. Feldt. P. 222.

Researches on the Variations of Magnetic Intensity in St. Petersburg. M. Kupffer. P. 225.

On the Connection between the Form and the Electric Polarity of Crystals. Tourmaline. M. Rose. P. 285.

New Proof of the Chemical Origin of Voltaic Electricity. M. Schonbein. P. 351.

On the Properties of Electric Currents propagated through Liquids. M. Matteucci. P. 398.

Description of Saxton's Magneto-electric Machine. P. 401.

New Voltaic Batteries, and Experiments with them. M. Callan. P. 407.

Experiments with Torpedoes. M. Colladon. P. 411.

On Variations of the Magnetic Intensity in St. Petersburg (concluded). M. Kupffer. P. 417.

Results of Experiments with Torpedoes. M. Matteucci. P. 485.

Vol. XL. (1837).

On Becquerel's Simple Oxygen Battery. M. Jacobi. P. 67.

On the Tendency of Negative Electricity to Escape more quickly into the Air than Positive. M. Belli. P. 73.

Remarks on Astatic Magnetic Needles. M. Minding. P. 151.

On some Actions of Friction-Electricity in relation to its Accumulation. M. Riess. P. 321.

Researches on Voltaic Electricity. M. de la Rive. Pp. 355, 515.

Notice on M. Becquerel's Chemically-acting Galvanic Battery, which produces no Elevation of Temperature. M. Pfaff. P. 443.

A New Voltaic Battery; Improvement on that recommended by Faraday. Mr. Young. P. 624.

On the Actions of a Voltaic Pile charged with Sulphate of Cupric Oxide. Mr. Warren de la Rue. P. 628.

Electric Sparks obtained from the Torpedo, and from the Thermo-electric Battery. M. Santi Linari. P. 642.

(To be continued.)

Les Mondes. Vol. xxxiv., No. 6. June 11, 1874.

Electrolytic Pile.—M. L. Maiche.—A description of this battery has already appeared in our pages (see Telegraphic Journal, vol. ii., p. 173). One general consequence of the construction of batteries is the wear of the elements composing them, even when the circuit is open: hence if they are unused for several days the current is rapidly weakened, and perhaps becomes *nil.* This inconvenience, very serious even for batteries of a weak electromotive force, such as those used in telegraphy, necessitates the complete taking to pieces of those of higher power each time we cease to use them, be it for a few hours only. These difficulties disappear with the electrolytic battery; the only attention consists in changing the zincs when they are used up, and in renewing the acidulated water. The expense is 1 centime per hour per element, for a surface of 3 square decimetres of worked zinc. Ten elements of this surface will use up in ten hours about 1100 grms. of zinc, costing 70 centimes: the loss of the mercury may be valued at 10 centimes, and the expense of the sulphuric acid 20 centimes,—total, 1 franc. If the proportions are accurately calculated, and the current entirely used, we can deposit in a galvanic bath a pound of copper equal to the equivalent of the zinc dissolved. Now to precipitate 1000 grms. of copper we must have 1127 grms. of zinc, whence it follows that the kilogramme of copper deposited by means of the electrolytic battery's current will cost 1 franc. Seventy elements used to produce the electric light cost about 50 centimes an hour. M. L. Maiche says that "the electric current follows a direction contrary to the generally received opinion, and is a fact of the highest importance, meriting an attentive examination. According to the old theory the current goes into the conducting wire from the iron (or copper) to the zinc. Does not this theory suppose the existence of an effect before its cause, confusing every explanation, and rendering researches based on its principles very difficult?" At a future time the author promises to point out "other not less important causes of error" whose study has been too much neglected until now.

No. 9. July 2, 1874.

Electro-Vigil.—An apparatus for the detection of fire, invented by M. Vincent Lanzillo, and already used with success in Italy. The principle of the invention is that increase of temperature beyond a certain point, arising from a conflagration, sets the apparatus in motion, and prints through a Morse the actual locality of the fire. For instance, in each room a thermometer is placed in the spot where danger is most likely to be apprehended. The thermometer has two wires inside the stem; one leading down into the mercury, the other near the top, or beyond the height of the ordinary summer temperature of the place. The other ends of the wires are in connection with the opposite poles of a battery. Should a fire take place the extraordinary rise of temperature causes the mercury to ascend, and thereby closes the circuit, which includes an electro-magnet. On the current being established this electro-magnet sets in motion an automatic manipulator, driven by clockwork and composed of a metal zone. Ivory and metal spaces, of longer or shorter duration, and corresponding to the dots and dashes of the Morse letters for the locality of the room, are let into the rim or circumference of this manipulator. The electro-magnet detaches a lever which, releasing the manipulator, sets the wheel in motion, so that the conducting and insulating surfaces make and break another circuit through a wire leading away to the watchman's office, where the Morse records the message on the wheel, viz., the particular room where the fire has broken out.

Nos. 10 and 11. July 9 and 16, 1874.

No papers suited to our columns are in these numbers.

The Journal of the Franklin Institute. Vol. xcvii., No. 581. June, 1874.

This part contains nothing relating to electricity or magnetism.

Scientific American, Vol. xxxi., Nos. 1 and 2, July 4 and 11, 1874.

No papers on electricity are in these numbers.

No. 3, July 18, 1874.

Electricity Produced in Mechanical Actions.—Certain phenomena of electricity of tension, observed in leather belting by M. Joulin, have recently been the means of directing the attention of that physicist to the subject forming the above heading. He has constructed machines in which the mechanical tension of the belt can be varied at will, and has used for conducting pulleys the following materials:—Iron, brass, zinc, red copper, white iron, lead (the last four metals applied in thin laminæ to wooden pulleys); the imperfect conductors, walnut wood, leather, hardened rubber, in sheets of

0·36 inch, applied to wood; cloth and silk fastened in form of cushions, also to wooden pulleys. In the machines formed of metal and leather, in the latter body electric tensions of surprising intensity were found. Independently of the long sparks obtainable, a metallic wire brought near the belt was traversed with a continuous current powerful enough to deflect the needle of a galvanometer, with electricity of tension to weakly decompose water, and in slightly modified Geissler tubes to produce a distinct stratification of the electric light. The circumstances influencing the electric production may be referred to three causes:—Separation, more or less rapid, of the bodies; the complex mechanical action of incurvation, depending, in the case of leather, on the elastic state and dimensions of the pulley, and the number of incurvations in a given time; lastly, the common temperature of the two bodies, or that of one of them.

Nature, Vol. x., No. 245, July 9, 1874.

On Vaporising Metals by Electricity.—The following simple results obtained by frictional electricity may be of interest; perhaps, too, of use in the investigation of certain minerals and the action of intense heat upon them. The description of a characteristic experiment is all that will be necessary to explain the process, and to show how similar results may be obtained from other substances. A very fine thread of sheet platinum, of about an inch in length, is placed between two microscopic slides of glass, and two pieces of thin sheet copper with rounded ends are placed in contact with the extremities of the platinum, the copper being any convenient length and breadth, so as to extend beyond the glass slides, but not to be as broad; a charge of electricity from about 8 square feet of Leyden jar is passed through the metals: the effect of the heat from the charge is to vaporise the platinum, which is instantly condensed in a transparent layer upon the cold glass. The layer can be investigated by a microscope, and employed in various ways to determine the character of the metal and its effect upon reflected or transmitted light. Copper, tin-foil, tin-foil amalgamated with mercury, gold, and silver, can be used in a similar manner, but they produce layers very dissimilar in appearance. To act upon finely-ground substances, such as vermillion, sulphate of antimony, sulphur, &c., a line of the powder must be made, and the charge be passed through in the same way as through the platinum. Part of the vapour escapes from between the slides, but this can easily be condensed upon each of two pieces of glass placed in such a way as to intercept the vapour as it passes from between the two slides; it is then condensed in a long but narrow line. The manner in which the glass is affected by the heat and the concussion produced by the expansion of the vapour are worthy of notice. Considerable difficulty will be found in vaporising copper, doubtless from its being such an excellent conductor. Some of the powdered substances appear to require a small spark to be passed through them before they allow a larger charge to pass, as if the particles needed polarisation.

No. 246, July 16, 1874.

Magnetic instruments are to be erected on a piece of ground situated between the Boulevard Arago and the Observatory Gardens, Paris. This land belongs to the French Government, which has given it up for the purpose mentioned.

THE Eastern Telegraph Company announce the repair, this day, of their direct Falmouth-Lisbon cable, thus re-establishing duplicate submarine communication with Lisbon, Gibraltar, Egypt, India, and the Far East.

City and Commercial Notes.

SPEAKING of telegraph securities, Mr. W. Abbott in his last circular says:—The inactivity which has been witnessed in other markets has also extended to these securities, and quotations have descended to a lower level than was observable a month ago. The dividends just announced are, however, by no means unsatisfactory, as, in addition to a fair return upon the money invested, the rational system of quarterly distributions of profits, adopted by the various Boards, has a most encouraging effect upon the minds of the investors. Submarine telegraphs are, however, still a new security to the great mass of the public, but the small denomination of the shares and the continuance of these quarterly dividends, together with the knowledge which the proprietors have that a sound principle of establishing ample reserve funds has been adopted, must ere long bring cable shares into greater prominence, and the advantages they offer to investors will no doubt gradually become more widely understood and appreciated. The increased inquiry lately noticeable for the shares of the Globe Amalgamation affords evidence of the attraction which telegraph property has when it is secured by a well-selected distribution of risk. The revenue of the Anglo-American Company continues to augment on a large scale, and it is extremely satisfactory to learn that the average time occupied in the transit of all messages between London and New York, during the month of May, did not exceed seventeen minutes and fifty seconds. This rapid working becomes startling by contrast with that nearer home: thus, a message from London to Paris occupies about one hour; and it is quite a matter of congratulation if, during the hours of business, the reply to a message from Paris can be received in London in less than two hours and a half; in fact, so perfect has become the organisation of the Anglo-American Company that messages can be forwarded from London to California and a reply received thereto in the same space of time as is at present occupied for a similar service between London and Paris. In the former case 11,000 miles have been traversed, whereas in the latter the distance to and fro does not exceed 500 miles.

At the recent meeting of the Telegraph Construction and Maintenance Company, the chairman (Sir Daniel Gooch) congratulated the proprietors on the completion of the two large contracts for the Brazilian Submarine and the Black Sea Telegraph Company. He stated that he was in favour of the formation of a trust for distributing to the proprietors the profit shares on the above contracts by means of certificates as before. The *Great Eastern* sailed on the 27th ult. to lay the new cable for the Anglo-American Company.

In the House of Commons, on the 27th ult., on the supplementary vote of £37,687 for the Post Office Telegraph Service, Mr. Smith explained that this vote was brought forward as a supplementary estimate in consequence of a change of practice which had only recently been introduced, and which he thought was a very desirable one. Until this estimate was presented it had been customary to charge the amount for annuities to the servants of the late Telegraph Company to the capital account, which was considered to be entirely improper. In answer to Mr. Fawcett, the Chancellor of the Exchequer said he was informed that the amount of business that was being done was largely in excess of that done last year, and that there was at present no reason to fear that the estimate which was given to him for the telegraph revenues for this year would not be realised. Lord J. Manners said that taking last month there were 200,000 more telegrams despatched and received than were despatched and received during the corresponding month of 1873, a gratifying proof of the immense development of this particular branch of the Post Office system. Mr. Goschen asked to what cause the decrease in the number of officers receiving annuities was attributable? Mr. Smith believed that the decrease principally arose from commutations. The Committee on Public Accounts recommended that pensions which were commuted should be charged to capital account, and that those which formed an annual charge should be charged to the revenue account, and that course had been adopted. The vote was agreed to.

The West India and Panama Telegraph Company (Limited) have issued a circular announcing the completion of the line between Para and Cayenne, which is in working order, but a fault is stated to exist about 109 miles from Para, and the steamship *Great Northern* has been ordered to the spot to effect the repairs. By the terms of the contract no payment becomes due to the Central American Company in respect of either of the sections—Para to Denmark, or Trinidad to Porto Rico—until its final completion and maintenance in perfect working order for thirty days have been certified to this company by Sir William Thomson or Professor Jenkin.

The Western and Brazilian Telegraph Company (Limited) have received intimation that the land lines connecting Rio Grande do Sul with Monte Video will be open for traffic about the 30th inst. Through telegraphic communication will be thus effected between Europe, the River Plate, and the West Coast of South America. The anticipated delay to through messages for Monte Video, Chili, &c., occasioned by the loss of the steamship *Gomas*, with the Rio Grande do Sul and Chuy cable, will thus be obviated.

A new cable between Shetland and Orkney has been successfully laid by the steamer *Caroline*.

TELEGRAPH SHARE LIST.

Amount per Share.	NAME OF COMPANY.	Amount paid up.	Closing Quotations.
£		£	July 30.
Stock	Anglo-American (Limited)	100	69¼—69¾
10	Brazilian Submarine..	All	7½—7¾
10	Cuba	All	6¼—6¾
10	Direct Spanish	9	..—..
20	Direct United States Cable	All	13½—14½
10	Eastern (Limited)	All	7⅞—8⅛
..	Do., New	..	102—104
10	Eastern Extn. Australia and China	All	7½—7¾
10	Globe Telegraph and Trust	All	6⅝—6⅞
10	Do., 6 per cent Pref...	All	9⅞—10⅛
10	Great Northern	All	10¾—11
25	Indo-European	All	15½—16
10	Mediterranean Extension (Limited)	All	4—4½
10	Do., 8 per cent Pref...	All	10½—11½
10	Panama and South Pacific	2½	..—.. dis.
8	Reuter's..	All	10¼—10¾
Stock	Submarine	100	215—225
1	Do., Scrip	All	1⅞—2⅛
10	West India and Panama	All	4—4½
10	Do., 10 per cent Pref.	All	10½—11
20	Western and Brazilian (Limited) ..	All	11—12
1000 dls.	West Un. U.S. 7 per cent 1st M.B.	All	102—104
10	Hooper's Telegraph Works	All	12—12½
50	India-Rubber and Gutta Percha ..	All	19—20
Cert.	Submarine Cables Trust	100	103—106
12	Telegraph Construction	All	27½—28
100	Ditto Ditto 7 per cent Bonds	All	103—105

Patents.

APPLICATIONS FOR LETTERS PATENT.

2074. J. Muirhead, jun., of Wimbledon, Surrey, for an invention of "Improvements in iron telegraph poles."—*Dated June* 15, 1874.

2179. R. H. Courtenay, of Meyrick Road, Clapham Junction, Surrey, for an invention of "Improvements in induction coils."—*Dated June* 23, 1874.

2235. E. Oesterley, of London, for an invention of "Improvements in duplex telegraphy, and in apparatus to be used for this purpose."—A communication to him from abroad by L. Schwendler, of Calcutta, India, electrician.—*Dated June* 27, 1874.

2380. E. E. Bean, of Boston, Massachusetts, U.S.A., engineer, for an invention of "A pneumatic electric gas-lighting apparatus."—(Complete specification.)—*Dated July* 7, 1874.

GRANTS FOR PROVISIONAL PROTECTION FOR SIX MONTHS.

1932. W. R. Lake, of the firm of Haseltine, Lake, and Co., London, for the invention of "Improvements in electric telegraphs."—A communication to him from abroad by L. Vianisi, of Messina, Italy.—*Dated June* 3, 1874.

1950. W. H. Clapp, of London, for the invention of "Improvements in apparatus for codeing telegraphic messages and for transmitting signals, parts of which improvements relate to signal and other lamps."—*Dated June* 4, 1874.

1954. W. P. Lyon, of Barnsbury, Middlesex, for the invention of "Improvements in the means or method of applying magnetism for curative and other purposes."—*Dated June* 5, 1874.

1966. J. W. Brown of London, electrical engineer, for the invention of "Improvements in the mode of and apparatus for transmitting telegraphic signals."—*Dated June* 5, 1874.

PATENTS WHICH HAVE BECOME VOID.

1770. M. Gray, of Highbury Hill, Islington, Middlesex, engineer, for an invention of "Improvements in the manufacture of electrical telegraphic conductors."—*Dated June* 17, 1867.

1771. M. Gray, of Highbury Hill, Islington, Middlesex, engineer, and L. Gibson, of the India-Rubber, Gutta-Percha, and Telegraph Works, Silvertown, in the county of Essex, for an invention of "Improvements in means or apparatus employed in examining the coating of electrical telegraphic communicators."—*Dated June* 17, 1867.

1917. F. T. Hubert, of Walworth, Surrey, and H. D. G. Truscott, of Walworth, Surrey, for an invention of "Improvements in the construction of general electric telegraphic machines and the mode of working them."—*Dated July* 1, 1867.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

4079. W. Rowett, of Liverpool, Lancaster. *Improvement in the construction and manufacture of electric telegraph cables or ropes, and in appliances connected therewith.* Dated December 11, 1873.—The novelty of this invention consists in covering the wire conductor with Rowett's non-masticated india-rubber; in placing two or more wire conductors in a single cable for ocean purposes, without adding to its bulk; in adding strength to the cable by filling its interstices with the strongest hemp or fibre lines, producing a solid spherical core; in preserving from decay all the hemp or fibrous material of which the cable is composed, by Rowett's preserving compound; in laying the strands of the envelope on the core with Rowett's preserving elastic marine glue round the electric conductor; in substituting an envelope of hemp prepared with Rowett's preserving marine glue round the electric conductor for the usual insulating compound of gutta-percha, india-rubber, &c.; and in making the cables of coir fibre, African or India grass or fibre, to produce light specific gravity; in making the envelope of wrong way yarn drawn from conical spindles instead of the bobbins now in use.

4100. F. Lambert, of St. Marylebone, Middlesex. *Improvements in grapnels for raising submarine telegraph cables.* Dated December 12, 1873.—My invention consists of an apparatus so contrived as to grip the cable securely and then sever the bight, one end only being raised to the surface. The apparatus resembles an anchor in form, being made with a shank furnished with a stock to ensure its dragging in the proper position for grappling the cable, and having two pairs of prongs forming a sort of open or skeleton fluke carrying the gripping devices, which consist of movable platforms fitted in guides or boxes, and provided with eccentric or cam-shaped jaws. These jaws are arranged to securely grip the end of the cable it is desired to raise, the platforms yielding under a certain pressure, bringing the bight of the cable between a pair of cutters.

4143. J. Neale, of Stoke-upon-Trent, Stafford, telegraph engineer. *Improvements in electric telegraphs.* Dated December 17, 1873.—This invention has for its object to enable the telegraphist to read or interpret the signals sent by a single needle or other commutator, both by the eye and by the ear, the sound produced by the motion of the needle in one direction being more acute or grave than that produced by its motion in the other direction. As a consequence of the interpretation of the signals by the ear, the telegraphist is at liberty to direct his attention more effectually to the recording of the message by writing. According to this invention the signalling apparatus consists of a dial plate, at the back of which a horizontal electro-magnet is fixed. Between the poles of this electro-magnet a small magnet or magnetic needle vibrates, which is kept midway between the said poles by light springs. By the passage in one or other direction of a current of electricity through the electro-magnet, the vibrating magnet or magnetic needle is deflected to the right or left, and signals may be read from it in the ordinary way with the eye. On either side of the vibrating magnet or needle is a sounding pin, the said pins being connected respectively with two sounding boards or drums, of such size and thickness of material as to produce sounds of different quality or pitch. As the vibrating magnet or magnetic needle moves to the right or left, it strikes one or other of the sounding pins, and the latter its drum. The sounds produced correspond with two motions of the vibrating magnet or needle, and are easily distinguished as signals by the ear.

4167. C. L. Madsen, of Copenhagen, Denmark, at present residing in Middlesex. *Improvements in electric telegraph cables and in insulating telegraph conductors.* Dated December 18, 1873.—This specification describes employing a compound of wax, resin, paraffin, and turpentine for insulating the conductors of telegraph cables and other electric telegraph conductors.

4171. G. Schüch De Capanema, of Rio de Janeiro, Brazil, but at present of Middlesex, professor. *Improvements in insulators for telegraph line wires, and in the means of securing the wires thereto.*" Dated December 19, 1873.—This invention relates to the construction of insulators for the line wires of electric telegraphs and to means of securing the wires thereto. The insulator of single or double bell shape supported on a stem is made wholly of non-conducting material with a crown projecting above. In this crown is formed a groove in which the wire is laid, the groove being widened out either at its centre or at its extremities for the reception of a collar or collars cast by an instrument like a bullet mould or soldered on the line wire. To prevent the line wire from rising out of the groove a cross pin or wire is passed over it through holes in the crown of the insulator.

4193. J. Rubery, of Hampstead, Middlesex. *Improvements in telegraphic wires or conductors.* Dated December 20, 1873.—The invention has for its object improvements in telegraphic wires or conductors, whereby lightness and strength are obtained, together with improved and increased conductive surface. For this purpose hardened and tempered steel wire is employed in the place of copper or other wires usually employed, and such wires are covered or coated with copper or other good conductor of electricity either by electro-deposition or by other means. Or the wires may be coated or covered with compound metals or bronze. For submarine or other purposes the above described telegraph wires are protected with india-rubber, gutta-percha, or other insulating materials. By employing hardened and tempered steel wire elongation when in use is prevented.

4277. H. Highton, of Putney, Surrey. *Improvements in electric telegraphs.* Dated December 30, 1873.—According to this provisional specification, the feeble received current is caused to excite an electro-magnet. Between the poles of this magnet is an armature wound with coils of wire. The armature is rotated at a rapid and uniform speed, and consequently a powerful current is caused to flow through the coils, and the strength of this current will vary with the magnetism of the electro-magnet. The instrument may be connected directly with the coils of the armature, or it may be arranged in a tertiary circuit.

UNITED STATES.

150,846. T. A. Edison, New York, N.J. *Telegraph relay.* Dated June 27, 1873.—Current of a small opposing local battery thrown through relay. A rheostat in its circuit enables it to be adjusted to first neutralise any current due to leaks.

151,004. C. A Browne and I. S. Browne, North Adams, Mass. *Electrical condenser.* Dated February 14, 1874.—Each metallic sheet is embedded separately in rubber, which is then vulcanised, and a series of these then used to form condenser.

151,100. V. H. de Forville, St. Petersburg, Russia. *Supports and connections for portable telegraph apparatus.* Dated February 24, 1874.—Attached to posts at intervals along line of railway, wires being brought down thereto, and continuity of circuit preserved through a plug connection between the plates to which the wires are led. When used with a portable apparatus, central plug is removed and circuit formed through instruments placed in support.

151,101. V. H. de Forville, St. Petersburg, Russia. *Portable telegraph apparatus.* Dated February 24, 1874.—Improvement on De Forville's previous patent. Intended to be carried on railway trains. Cam wheels actuating key connected by a yoke, having a finger taking into spaces of comb, so as to fasten the series when proper cam wheel is under key. Case containing apparatus is temporarily fastened, when used, to a second box having contact plates corresponding to central plate in brackets placed in posts at suitable intervals along line of railroad.

148,289. M. G. Farmer, Salem, Mass. *Apparatus for firing fuses by electricity.* Dated June 21, 1873.—Upon a suitable base are two keys, one single and one double, and a galvanometer, so arranged that when, by proper connecting wires, a feeble current is completed through the fuse it will be shown by the galvanometer when the double key is closed; but when the other key is closed at the same time the galvanometer coil is cut out, and the direct current thereby sufficiently increased in intensity to fire the fuse.

148,403. W. W. Batchelder, New York, N.Y. *Electric gas lighter.* Dated June 27, 1873.—The lower plate of a portable electrophorus is pulled down by a pivoted thumb lever, which is held by a spring against the edge of the upper or fixed plate. On applying the thumb to the lever its contact with the upper plate is broken in an instant before the lower plate is withrawn.

148,338. T. Varney, San Francisco, Cal. *Electric Fuse.* Dated November 15, 1873.—An electric fuse composed of a single shell containing the requisite fulminate or detonating powder, the electro-sensitive powder, and the ends of the conducting wires, all in proper contact, and secured therein by sulphur, or its equivalent, substantially in the manner and for the purpose set forth.

148,447. A. Hahl, Washington, D.C. *Electric indicator for elevators.* Dated February 7, 1872.—Indicator on elevator is connected by a flexible conductor to a stationary battery and to circuit closers on each floor. 1. The circuit making and breaking apparatus, and the connecting conductor, in combination with an indicating apparatus, arranged upon the car so as to be movable therewith. 2. Weight and pulley in combination with the cable of an electrical indicator for elevators.

148,459. W. C. Holman, West Meriden, Conn. *Electro-plating apparatus.* Dated December 27, 1873.—Upon a certain determinate weight of plate being deposited on the articles in the bath a weighted arm is pulled down, simultaneously breaking the circuit to the bath and articles, short circuiting the battery, and operating an alarm.

148,469. J. B. Kerz, Mainz, Germany. *Electric clock.* Dated January 9, 1874.—An elastic arm attached to one of the arbors of a clock train, at each revolution, strikes a stud, against which it is first strained, then suddenly passes and strikes a connecting key, which completes an electric circuit through an electro-magnet in a clock at a distance. The magnet operates the hand-moving mechanism of the distant clock.

148,517. J. Y. Smith, Pittsburg, Pa. *Ore separator by use of magnets.* Dated February 18, 1874.—The magnets are arranged to form a cylinder, around which passes a belt and other intricate arrangements.

148,608. J. H. Guest, Brooklyn, N.Y. *Automatic fire alarm and circuit therefor.* Dated February 7, 1874.—A number of thermostats, placed in main closed circuit of a district alarm or other telegraph line, close, when acted on by heat, a branch circuit through an alarm and signal mechanism without destroying continuity of main circuit.

148,667. E. Casselberry, St. Louis, Mo., and N. H. Edgerton, Philadelphia, Pa. *Electrolytic apparatus.* Dated April 19, 1873.—The terminal points or electrodes within the liquid are increased until a path is furnished, the current to the point of action having a minimum of resistance, thus utilising the greatest amount possible for electrolysis. The apparatus for electrical decomposition, consisting of a decomposing tank or receptacle, and the bifurcated or divided conductors within such receptacles, substantially as and for the purpose described.

148,768. J. E. Smith, New York. *Printing telegraph.* Dated August 23, 1872.—Unison stop. Improvement on stop in patent 127,111. Unbalanced stop lever loose on shaft moves by gravity to engage pin on type escapement wheel, and is released therefrom by blow from a lever, paul and ratchet preventing recoil. Index affixed to show proper adjustment of spring of escapement lever.

148,833. J. F. Kirby, Boston, and F. W. Nichols, Lynn, Mass. *Fire alarm telegraph apparatus.* Dated December 31, 1873.—Adjoining signal box is a closet, into which a person desiring to give an alarm, and not having a key to open the box with, enters, closes, and throws a bolt which passes into the signal box, starting it, at the same time locking himself in for a time, so that he may be detained until the correctness of the alarm be ascertained.

148,910. A. Wilkinson, London. *Composition for coating telegraph wires.* Dated February 20, 1874.—A preserving compound for telegraph and other electric wires, composed of white lead, pitch (or rosin or tar), japan, shellac or its equivalent, tallow, naphtha, and oil, in or about the quantities specified, and capable of being applied either directly to such wire or wires, or by application to any fibrous or textile material covering said wire or wires, or by saturating such fibrous or textile material previous to enveloping the wire or wires, substantially in the manner and for the purposes specified.

148,938. F. de Hondt, Chicago, Ill. *Facsimile telegraph.* Dated July 15, 1873.—Clock-work revolving, transmitting, and receiving cylinders controlled by a verge attached to a polarised armature. To shaft carrying escape-pin taking into verge is fixed a mechanical pole changer; gives an intermittent rotary motion to the cylinders, but secures their unison. Message written in insulating ink on foil. While stylus travels over foil a short circuit is made, which is broken by insulating ink, sending current over line.

148,946. M. Gally, Rochester, N.Y. *Printing telegraph.* Dated February 23, 1874.—Reciprocating sending key, transmitting both for code and printing receivers simultaneously. Balanced frictional escapement keeping motor uniform.

148,956. W. Humans, Cambridge, Mass. *Magnetic telegraph apparatus for students' use.* Dated February 7, 1874.—Permanent magnet pivoted and depressed by a key until its other end is brought sufficiently near the sounding part to attract the same.

149,152. F. L. Pope, Elizabeth, N.J. *Electric railway signal.* Dated December 21, 1873.—Series of semaphoric signals operated by electro-magnets. Signal operating circuit closed by wheels and axles of train, bridging rails of insulated section. Signal kept in position after circuit is broken till released, by current sent back from next signal series after train has passed latter. Secondary signal, placed ahead of primary circuit closer, operated automatically by primary signal after latter is set.

149,252. W. E. Sawyer, Washington, D.C. *Telegraph apparatus for cable use.* Dated February 12, 1874.—Depression of a key closes circuit to key-locking devices and to magnets G, bringing arm D into revolving wheel H, causing partial revolution of cylinder B, which closes circuits to keys E or F as a + or − current is to be sent over the cable. All currents are used for signals.

149,320. R. M. Lockwood, New York. *Galvanic battery.* Dated March 7, 1874.—Copper rests on sulphate of copper, zinc connected thereto by insulating pillars, so that their distance apart remains constant. Flexible skirt fastened to edge of copper, and bearing against sides of cell.

149,527. H. C. Royer, Cleveland, Ohio. *Telegraph sounder.* Dated March 3, 1874.—Electro-magnet itself vibrates, being provided with an extended core, pivoted at one end to a plate.

149,539. H. Splitdorf, New York. *Telegraph sounder.* Dated February 26, 1874.—Castanets or other sounding cups operated by armature lever.

149,561. E. E. Bean, Boston, Mass. *Electric gas lighting apparatus.* Dated June 6, 1873.—A small Bunsen burner near the main burner is lighted by the electric spark when the circuit is closed and the gas turned on, and the blaze from it ignites the main burner, immediately after which the small burner is extinguished; all operated automatically by clockwork and pneumatic apparatus.

149,635. M. Breslin, New York. *Galvanic battery.* Dated November 4, 1873.—The copper or negative plate made in conical or pyramidal form, as set forth, whereby the operative surface is increased, as the sulphate of copper is consumed, as specified.

149,677. F. L. Pope, Elizabeth, N.J. *Electro-magnetic alarm.* Dated March 5, 1874.—Armature carrying two bell hammers acted on by two magnets alternately, the current being shifted after a full stroke has been made in either direction by one to the other.

149,762. C. L. Le Barron, Pensacola, Fla. *Telegraph insulator.* Case B. Dated January 16, 1874.—A telegraph insulator formed of a block of insulating material and provided with an aperture for the spike, having concave ends to receive washers, and also provided with a circumferential groove at right angles to the spike aperture to receive the tie wire, as shown and described.

149,797. E. W. Siemens, Berlin, Germany. *Magneto-electric apparatus*. Dated January 20, 1874.—One pole of permanent magnet bent, extended and provided with an aperture into which the other pole takes, the coil being placed in the space left between the two poles.

149,907. W. C. Baker, New York, N.Y. *Electric steam boiler alarm*. Dated March 21, 1874.—Tube, expansible by heat, placed in case connected to boiler. If water falls so tube is exposed to steam; increase of temperature causes it to close circuit to an alarm. Another circuit to same alarm is controlled by a pressure diaphragm. Testing circuit from point where alarm is situated is connected to whole apparatus.

ATMOSPHERIC TELEGRAPHY.—An interesting exhibition of telegraphic machines, worked exclusively by air, was recently held by Mr. Guattaris, the inventor, in the Pillar Hall of the City Terminus Hotel, Cannon Street, A number of different instruments were on view, but the motive power in every instance was excited by the impulse given to a column of air at one end being transmitted instantaneously to the other end of the column, and taking effect upon certain mechanical arrangements so as to produce such results as might be required. The impulse is produced at one end of a tube by the operator, and performs the mechanical work at the other end either by ringing a bell or turning a needle round a dial. Mr. Guattaris claims for his invention a superiority over others in the fact that by it a complete message can be despatched by its means. Mr. Guattari's instruments are only worked by a single tube, along which the air is impelled in each direction. The rapidity and precision can be made equal to the electric telegraph, the conducting tube being able to be laid under or over cover in the same manner as the ordinary telegraph. Attached to each machine is a bell and dial, and the message is transmitted by the moving of a small lever which drives the air through a pipe to the other operator. As the lever is moved up and down the dial, which stands where the message is destined for, registers whatever the words may be. Each dial is supplied with a needle, and as each spurt of air presses against the works of the machine the needle is moved exactly the number of times that the lever is pressed. Each instrument can either receive or send a message. The mechanism is not likely to become disarranged; but it appears that the invention will not transmit messages any great distance. By the aid of compressed air the inventor has succeeded in conveying a message 10 miles, but without compressed air the present limit is about 400 yards. The instruments exhibited were designed for intercommunication between large coffee-houses, offices, hotels, and vessels.

THE Atlantic and Pacific Telegraph Company are erecting a line of telegraph between Chicago and Omaha, 500 miles, using a charcoal iron galvanised No. 10 wire, and twenty-two cedar poles to the mile, with Brooks's insulators. The line is constructed by George H. Bliss and Co., of Chicago. It is to have twenty-two relays in the circuit, and the guarantee of the contractors is that it works in the rain or most humid weather, in a single circuit upon that length, to the full Morse speed of any line in clear weather, and better than a No. 6 wire on ordinary insulators. Such wire cannot be worked with that number of relays in rain without an intermediate repeater, and, with a repeater, no line can be said to be worked at full capacity of a shorter wire without repeaters. The resistance of this circuit will be equal to a No. 6 wire 3000 miles in length. The cost of this model line per mile is not half that of a No. 6 wire upon ordinary insulators; hence the economy of using a better insulation. Six years since Mr. F. L. Vandenburg constructed a line of two wires from Ogden to San Francisco, 1000 miles, using a No. 9 wire, except on the portion over the mountains, where a No. 11 steel wire of greater strength was substituted. At the time many doubted whether this line could be worked in one circuit, on account of the great length and resistance, especially in the rainy season, but with the Brooks insulators there has never been any difficulty. In a letter from Mr. Vandenburg, dated San Francisco, May 23, incidentally referring to this line, he states,—"My 1000 mile circuit works as well as when first completed."—*Telegrapher*.

NEW OFFICE OF THE WESTERN UNION TELEGRAPH, BALTIMORE.—The Western Union Telegraph Office has been removed from the south-west corner of Baltimore and South Streets to the corresponding corner of Baltimore and Calvert Streets, in the newly improved building of Alexander Brown and Sons. The arrangements in the new telegraph office are of the most complete character, and will vie with any office in the country. The receiving-room is handsomely tiled, and is furnished with a counter and top of unique design and most elegant finish. As messages are handed in they are dropped into a pneumatic tube, and drawn by air-suction to their destination on the third floor, where the operating room is situated. The latter contains eighteen quartette tables, having on them seventy-two telegraph instruments, by means of which direct communication is had with all the various cities and towns in the United States. A novelty here is the use of an inverted glass insulator set in the tables as inkstands; another feature is the clothes wringer, arranged for copying messages, and through which will pass several thousand messages every day, the duplicate press-copy being kept for record, the original message not being detained an instant for entry of any kind, being dropped from the press table to the delivery clerk on the first floor, who notes the number on his book, and sends the message to the party for whom it is intended. The switch board for making necessary wire changes is of the highest style of art, and is said to have cost as it is now placed upwards of 5000 dols. The Company has 150 wires connected with their new office. The officers of the Company are as follows:—Arch. Wilson, jun., President; Thos. T. Eckert, General Superintendent; D. H. Bates, District Superintendent; J. J. Riley, Cashier; Chas. C. C. Wolff, Day Chief Operator; and J. F. Morrison, Night Chief.

To Correspondents.

*** Duly authenticated contributions, theoretical and practical, on every subject identified with the interests of which "THE TELEGRAPHIC JOURNAL" is the organ, will always command attention. Anonymous correspondence will be wholly disregarded. Literary communications and books for review should be addressed to the EDITOR; business communications to the PUBLISHER.

SUBSCRIPTIONS.

Copies of the journal may be obtained through newspaper agents in every part of the world. Should any difficulty arise in procuring copies, direct communication with the PUBLISHER is requested.

Gentlemen desiring to subscribe and receive this paper regularly, are requested to send a remittance to the Office at Boy Court, Ludgate Hill, London, E.C., for 9s., if residing in the United Kingdom; if in Africa, Australia, Belgium, Brazil, Canada, Egypt, France, Gibraltar, Jamaica, Malta, Mexico, Monte Video, Natal, New Zealand, Sweden, United States, West Indies—10s.; if in Austria, Ceylon, China, Holland, India, Italy, Japan, Portugal, Germany, South America (West Coast), Spain, Switzerland, Turkey, Valparaiso—12s.; if in Russia, 14s.

Cheques and Post Office Orders to be made payable to HENRY GILLMAN, and to be crossed "London and County Bank."

ALL SUBSCRIPTIONS PAYABLE IN ADVANCE